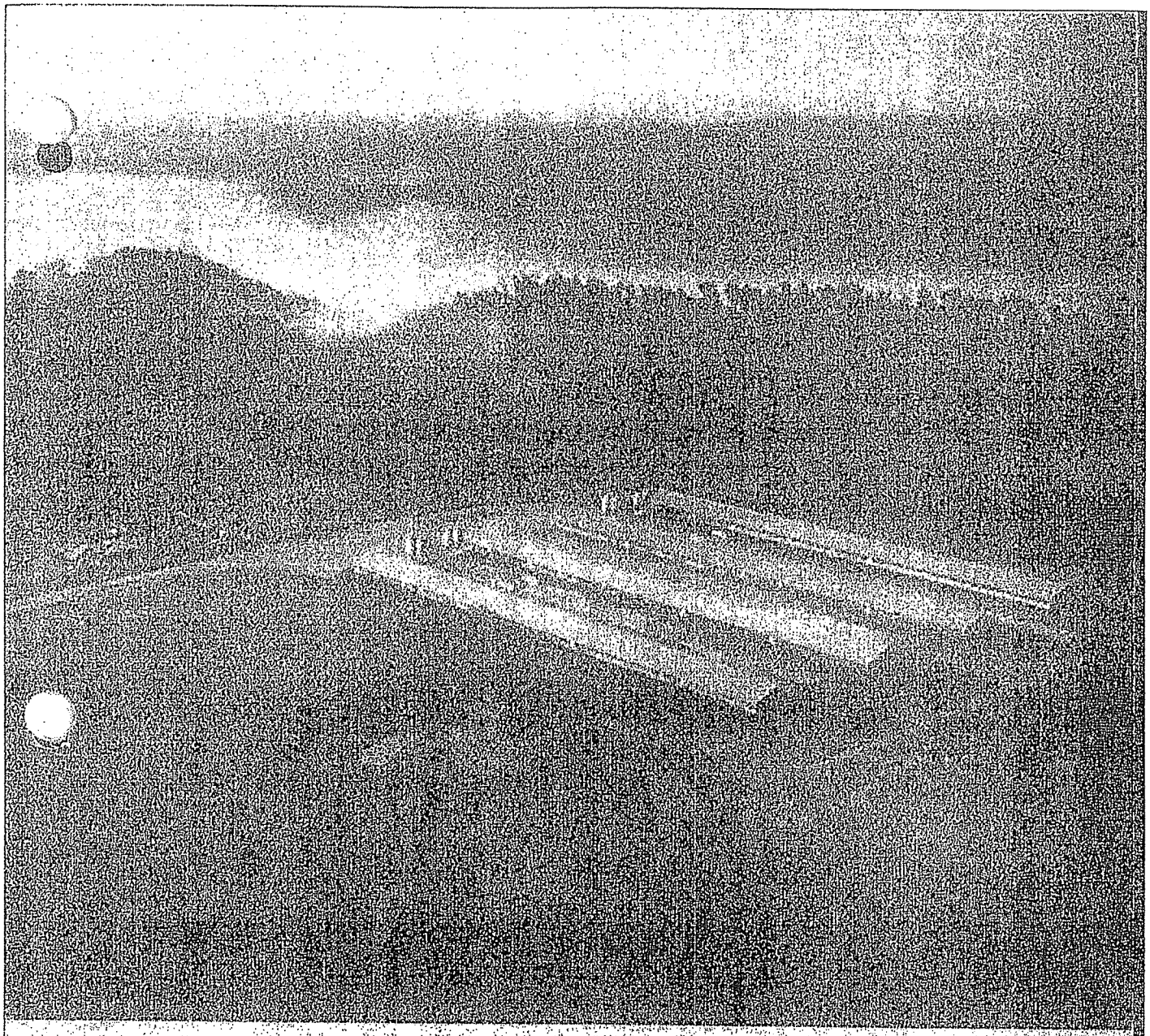


Tyson

Environmental Poultry Farm Management

INTRODUCTION

Agricultural activities are receiving an increasing amount of attention for allegedly contributing excess nutrients to our country's water resources. Nutrient management planning, together with proper land application, can reduce adverse impacts. Potential impacts are eliminated as growers learn to implement proper soils and litter management procedures.

Nitrogen

Most of the nitrogen found in poultry manure or litter is in the form of organic nitrogen. A smaller amount of the nitrogen in the manure is ammonium. Organic nitrogen can be mineralized or converted by soil bacteria into inorganic nitrogen. In this form, nitrogen is readily available for plant uptake. Excessive organic and ammonium forms of nitrogen can be transformed into nitrate nitrogen. High levels of nitrate can be harmful to human health. Excess nitrogen can be removed from application sites by surface runoff and leaching, and then flow into surface and ground water sources.

Phosphorous

Poultry manure is also composed of relatively large amounts of phosphorus. Phosphorus is essential for plant and animal nutrition. In the soil, phosphorus is made-up of inorganic and organic forms. Both forms interact to release water soluble phosphorous which can then be used to meet the nutritional requirements of the plants and vegetation.

Phosphorous laden soils can be eroded by rainfall and the particles can then be transported into surface water sources. Excessive phosphorus in surface waters can cause excessive plant and algal growth. Excessive algal growth can contribute to fish kills by depleting the dissolved oxygen content of the water.

Producers must implement proper land application management practices for manures with high phosphorous concentrations. Adopting conservation practices which reduce soil erosion will lower the potential for phosphorus being introduced into surface waters. Manure application rates based on nitrogen plant requirements can lead to phosphorous buildup in soils. The practice of rotating crops and application sites will help remove excess phosphorus. Maintaining soil pH between 6.0 and 7.0, maximizes plant phosphorus uptake, thereby reducing accumulations.

Producers should also implement an annual soil sampling program for application fields to determine nutrient concentrations and to help calculate application rates. Further applications should not be made to soils containing excessive phosphorus amounts.

Potassium

Potassium is another important nutrient contained in poultry manure. Potassium is rather mobile in the soil, but is available to supply plant nutritional requirements. Excessive potassium, though, can cause adverse plant health impacts. Proper soil monitoring is important for ensuring plant production.

Heavy Metal and Trace Elements

Poultry manure can contain trace amounts of copper, selenium, nickel, lead, and zinc. Over application of manure with high concentrations of these minerals can exceed the soil's adsorptive capacity. In addition to harming plant health, over application can increase the potential for water impacts.

Usage of Manure Nutrients

The nutrients in poultry litter are an excellent soil conditioner and fertilizer. Poultry growers must maximize the benefits of these nutrients while minimizing impacts to ground and surface water sources. Soil and litter sampling results allow producers to monitor their nutrients to meet plant needs and preserve water quality.

COMPANY POLICY

Best Management Practices
Dry Litter Disposal & Dead Bird Disposal

Tyson has a long-standing commitment to protecting the environment wherever we have operations. This applies to our processing plants, hatcheries, feed mills, and all other aspects of live production. Due primarily to increasing concern for safe drinking water, Federal and State governments are under considerable pressure to regulate and/or mandate restrictions on the use of animal wastes. Unless both Tyson and our Producers act to address these concerns, the use of poultry litter could be severely restricted in many locations. Dead bird disposal methods have also been addressed for the same reasons.

The following ***requirements*** are necessary to optimize our environmental stewardship. ***Any Federal, State or local regulations in these areas take precedence and must be complied with.***

Dry Litter Disposal

Regulations

Federal, State, and County regulations are becoming more prevalent in dry manure management. Where these regulations are in place, it is our responsibility to follow them completely. Tyson feels a responsibility to communicate and educate all Producers to be good stewards of the environment by the use of Best Management Practices.

Regardless of regulatory requirements, it is Tyson's expectation that we minimize the environmental impact of dry litter disposal for the long-term welfare of the communities we live in. The following are the minimum requirements.

Nutrient Management Plan

A good Nutrient Management Plan involves determining the soil requirements, the nutrients in the litter, and applying the proper nutrients at agronomic rates for the crop intended. The Plan should demonstrate methods of litter usage as a fertilizer that maximizes plant uptake and minimizes adverse impacts. Best Management Practices also dictate such things as the development of buffer zones between bodies of water and the application sites and rotation of application fields to prevent buildups of any particular mineral. Each Nutrient Management Plan will, therefore, be site-specific.

Most mandatory regulations require that Nutrient Management Plans be updated when the animal population increases by 10% or more, whenever there has been a significant change in the operations, or no less than every five years. The Nutrient Management Plan should

include manure application volumes, application sites, the crop to be using these nutrients, and timing of the application throughout the year.

These Plans must be prepared by a person certified through the Natural Resources Conservation Service. To develop a valid Nutrient Management Plan, you should contact the Natural Resources Conservation Service, Soil & Water Conservation District, Cooperative Extension Service, or in some cases, a certified private engineer.

Soil Samples

Soil from fields receiving applications of poultry litter should be sampled for a standard soil fertility analysis. The analysis should be utilized to manage the nutrients in the soil, which will prevent a build-up of nutrients that could result in adverse water quality. The soil should be sampled for nitrogen, phosphorus, and potassium content at a minimum. The Producer should then rotate application fields having nutrient concentration to prevent any build-ups of mineral.

A representative soil sample from each litter application site should be taken and analyzed annually. It is recommended that all soils be sampled prior to application. The Cooperative Extension Service should be available to conduct the laboratory analysis and to provide information on the proper time and method to collect the sample.

Producers should retain the lab results for a minimum of three years.

Litter Samples

Litter samples should be utilized to determine the fertilizer potential of the litter and to calculate the application rate. The litter should be sampled for nitrogen, phosphorus, and potassium content at a minimum. In some states, a standard or average nutrient content of the litter has been determined through extensive study and is acceptable. However, these standards or averages are typically very broad, and with the proper documentation of your own representative litter samples, you may be able to land apply more than the standard would allow.

Samples should be taken from each house in such a way that they are representative of the litter throughout the house. These should be collected and analyzed annually. The Cooperative Extension Service should be available to conduct the laboratory analysis and to provide information on the proper method to collect the sample.

Producers should retain the lab results for a minimum of three years.

Litter Cleanout & Application

Effective utilization of manure is possible if you know how much is being spread over a given area. Therefore, litter application equipment should be calibrated prior to usage to ensure the volumes detailed in the Nutrient Management Plan to improve utilization of the nutrients in the manure and reduce the potential for nutrient runoff. Manure should not be applied when the soil is saturated, covered with ice or snow, during precipitation, or when significant precipitation is expected within 24 hours.

Manure should be land applied immediately after its removal from the poultry houses. Any manure stockpiled for later use must be covered in a manner to prevent contact with precipitation. The preferred method of storage would be in a covered dry stack storage structure. The bottom or base of the storage structure should be constructed of either concrete or impermeable clay to prevent ground water contamination.

Buffer zones and vegetated filter strips, as detailed in the Nutrient Management Plan, should be maintained during application. Buffer zones should be no less than 100 feet from all water sources or 50 feet from neighboring occupied dwellings, except where state law dictates otherwise. Most states or counties will have additional guidelines available through the Cooperative Extension Service.

Producers should maintain litter application records detailing the volume, application rate, the acreage covered, and the date of all litter applications. The site or field of manure application should also be recorded, and should only be made on soils detailed in the Nutrient Management Plan. Records should be available for review and be retained for a minimum of three years.

Managing Dry Poultry Litter to Prevent Spread of Disease

While environmentally sound management of poultry litter is important, there are also potential impacts on poultry health, related to movement and spreading of dry poultry litter. Producers realize the importance of disease control and biosecurity related to managing poultry farms, but managing dry poultry litter in a biosecure manner is a tool that can be used to prevent or reduce disease spread.

Even when disease problems are not present in flocks where litter is being removed from houses, litter should be removed from farms only on covered trucks and spread well away from other poultry operations.

Litter from poultry houses where disease problems are present is a potential source of disease infection for other poultry. Used litter contains insects and other poultry disease-causing organisms. Spreading this litter can spread insects and diseases from one location to another. Measures should be taken in all instances to reduce the potential for disease spread, but especially if diseases such as Laryngotracheitis Virus (LT), Avian Influenza (AI), or other infectious transmittable diseases occurred in flocks that were raised on the litter being

removed from a house. Handling dry poultry litter in a responsible manner as related to disease prevention and control becomes even more critical under these circumstances.

Sale of Dry Poultry Litter

Since the generator of the litter is ultimately responsible and liable for the litter if any litter mishandling occurs, Producers selling or giving away the manure from their operations should ensure the landowner receiving the manure has implemented a site-specific Nutrient Management Plan prior to application as well. The Producer should supply the landowner a copy of the most recent litter analysis and maintain records of all sales or transfers of manure, which will include the name and address of the buyer and location of the application site. In addition, an agreement form to transfer or assign the responsibility for the litter's proper utilization may be utilized to help provide a paper trail in the event of future regulatory action.

Training

Producers should attend voluntary training programs on nutrient management, which Tyson will coordinate with the Natural Resources Conservation Service or a similar agency in your area. In most states, the local Cooperative Extension Service has also developed information pamphlets that can help Producers better manage manure application. The information includes best management practices to be utilized for the most economical and practical use of their litter.

Compliance

Because of the critical nature of managing dry litter disposal, Tyson must expect its Producers to comply with "Best Management Practices." If repeat violations of the "Best Management Practices" are documented, the Company will withhold placement of birds until an agreement to comply is obtained.

Dead Bird Disposal

Regulations

Federal, State, and County regulations are also becoming more prevalent in dead bird disposal. Where these regulations are in place, it is our responsibility to follow them completely.

Regardless of regulatory requirements, it is Tyson's expectation that we minimize the environmental impact of dead bird disposal through the utilization of Best Management Practices for the long-term well being of the communities we live in. Approved methods for dead bird disposal vary by state.

Methods

Acceptable methods for disposal of dead birds include:

Composters
Incinerators
Digesters
Freezers (store birds for rendering)
Rendering – Tyson approved
Pits - Not acceptable in many states. Where allowed, must follow state guidelines.
Burial – Available in some states in catastrophic circumstances.

It is **unacceptable** to leave dead birds piled outside the poultry house where dogs and varmints can carry them off. This practice leads to a concentration of varmints, and the carcass remains spread by dogs or varmints will be objectionable to neighbors. Obviously, birds of prey feeding on dead carcasses also spread unwanted diseases.

Approved methods for disposal of dead birds vary from state to state. Your Technical Advisor can advise you on the approved methods of dead bird disposal for your state.

Compliance

If unacceptable dead bird disposal methods are observed, or if there are complaints from neighbors or regulatory agencies, Tyson will ask the Producer to utilize Best Management Practices. If acceptable practices are not utilized, Tyson will withhold placement of birds until a satisfactory agreement is reached.

NUTRIENT MANAGEMENT

NUTRIENT MANAGEMENT PLANS

Land application is the best use of the nutrients in poultry manure. It is relatively inexpensive and is environmentally safe if managed properly. To protect against over-application, the nutrient concentration of the manure must be known. Application rates can be calibrated to maximize plant nutrient uptake when manure nutrient concentrations, soil fertility, and crop nutrition requirements are known.

A site-specific nutrient management plan can consist of the following:

-- farm site maps
-- projected crop yields
-- soil and manure testing results
-- buffer zones and filter strips
-- application rates based on a limiting nutrient
-- Best Management Plans
-- method(s) to calibrate application equipment

The Natural Resources Conservation Service, Cooperative Extension Service, and other agricultural research agencies have prepared tables of the average concentrations or amounts of key nutrients found in many animal manures. Tables are included with this handbook for the estimation of the nutrient content of poultry manure. Site-specific testing results, though, are the best source of information to prepare the Nutrient Management Plan.

Once the Nutrient Management Plan has been implemented, it should be reviewed and updated at least every five years to ensure the Plan's effectiveness. The Plan can save the producer money be reducing the amount of commercial fertilizer which may be purchased.

Land Application

One of the most important elements of land application is to apply manure during the plant growing season. The amount of manure applied, the timing of the applications, and the application method used, combine to maximize the benefits of the nutrients.

Poultry manure broadcast upon the surface will lose a significant portion of its volatile nitrogen compounds. Poultry manure applied to soils which are frozen or snow covered has a much higher potential for runoff to surface water sources. Application should not be made proximal to water wells, springs, or sinkholes or on hillsides with slopes greater than 15%.

Incorporation of the manure into the soil increases the amount of available nutrients and reduces the potential for adverse impacts to water quality. Incorporation

results in little disturbance to the soil surface and is appropriate for till and no-till systems.

POULTRY NUTRIENT MANAGEMENT

The majority of producers will apply poultry manure to their pastures or croplands which will be used as fertilizer. To maximize fertilizer usage, growers must develop and implement Nutrient Management Plans before the manure is actually removed from the poultry houses. The Management Plan can protect water quality and will provide for economic returns to the producer.

To protect our natural resources and yet remain profitable, poultry producers must utilize the most up-to-date and accurate site-specific sampling data to develop their Nutrient Management Plans. The Natural Resources Conservation Service is a grower support agency that can develop the Plans for growers. Growers can use one the following models to implement an "unofficial" management plan while the Natural Resources Conservation Service develops the site-specific Plan.

Nutrient management incorporates the nitrogen, phosphorous, and potassium content of the manure with the nutrient requirements of the crops growing in the application field. Proper planning prior to manure application, reduces the wasting of valuable nutrients. Proper nutrient management minimizes adverse impacts which can result from nutrient over-application. Accurate nutrient planning can also reduce the need for commercial fertilizer.

To obtain the most benefit from manure nutrients, while eliminating surface and groundwater contamination, the following should be implemented by the Producers:

-- apply for an Animal Waste Management Plan
-- determine the limiting nutrient for application
-- analyze manure and application site soils annually
-- match manure application rates to meet plant requirements
-- calibrate waste application equipment prior to usage
-- incorporate manure into the soil, if required
-- do not apply manure to frozen or saturated soils
-- apply manure during the active plant growing season
-- store manure properly prior to application
-- establish and maintain filter strips between application sites and water sources.

Training, technical assistance, and financial aid is available to help growers identify and correct problems using poultry manure. The Natural Resources Conservation Service and Cooperative Extension Service are two grower support agencies that can provide assistance.

NUTRIENT MANAGEMENT PLAN DEVELOPMENT

Producers must develop Nutrient Management Plans to prevent excess soil nutrient accumulations which could result in surface and ground water contamination. The Plan must match the crop nutritional requirements with the nutrients available in the manure. The value of the manure depends on its nutrient composition and application practices.

The purpose of the Nutrient Management Plan is to determine the number of acres of pasture or cropland needed for the proper manure application. The Plan will usually have nitrogen or phosphorous as the application limiting nutrient. A limiting nutrient is usually that which will have the greater adverse environmental impacts if application is mismanaged. Plan development requires realistic crop yields in the application areas, their nutrient requirements, and proper timing of application for maximize plant use.

The following information can be used to develop and utilize a Nutrient Management Plan:

1. Obtain aerial photographs for each field identified to receive manure
2. Obtain a soils survey booklet from the Natural Resources Conservation Service
3. Determine fields available for land application
4. Realistic Yield Expectations from soil survey or site-specific data base
5. Litter nutrient composition from one of the site-specific litter analysis or one of the enclosed tables.

Example One:

Follow the enclosed "Worksheet for Crop Nutrient Requirement" and Tables 1 and 2 to develop a Nutrient Management Plan for your farm. The example uses nitrogen as the limiting nutrient for the calculation manure application rates.

Example Two:

Tables 3 has been added along with another sample worksheet from Example One to determine phosphorus application rates. Note: the resultant application rate is for nutrient uptake only. Phosphorus based application rates are usually calculated on the soil's capacity to assimilate phosphorus rather than on plant phosphorus uptake rates. This is the reason why soil samples are so important. Sampling can alert the producer to excess phosphorous accumulation in application site soils.

Example Three:

A third example entitled "Determine Rate of Broiler Litter Application" is enclosed for reference. This example will help the producer determine phosphorous application rate.

Finally, a worksheet for calculating the volume of manure produced at the farm is included. While worksheets will provide an estimated quantity of litter being generated, poultry operations should establish their own records. The quantity of litter being removed from a poultry house can be determined by litter spreader calibration and calculating the number of loads from the poultry houses.

Worksheet for Calculating Poultry Litter Production

The total amount of litter removed from farm production facilities can be estimated by the following method. The amount is somewhat dependent on the type and amount of litter added initially and may vary by as much as 20% depending on the farm practices.

Broiler House Litter	Example	Actual
a. Number of birds per flock:	25000	
b. Number of flocks per year:	5.8	
c. Pounds market live weight per bird:	4	
d. Tons litter per 1000 birds per flock:	1	
e. Tons litter per year (a x b x d /1000):	145	

Broiler House Manure Cake	Example	Actual
a. Number of birds per flock:	25000	
b. Number of flocks per year:	5.8	
c. Pounds market live weight per bird:	4	
d. Tons litter per 1000 birds per flock:	0.34	
e. Tons litter per year (a x b x d /1000):	50	

Broiler Stockpiled Litter	Example	Actual
a. Number of birds per flock:	25000	
b. Number of flocks per year:	5.8	
c. Pounds market live weight per bird:	4	
d. Tons litter per 1000 birds per flock:	1	
e. Tons litter per year (a x b x d /1000):	145	

Broiler Roaster House Whole Litter	Example	Actual
a. Number of birds per flock:	12500	
b. Number of flocks per year:	4	
c. Pounds market live weight per bird:	8	
d. Tons litter per 1000 birds per flock:	2.6	
e. Tons litter per year (a x b x d /1000):	130	

Broiler Roaster House Whole Litter	Example	Actual
a. Number of birds production facility capacity:	8000	
b. Days per year birds in production facility	365	
c. Pounds market live weight per bird:	6	
d. Pounds litter per 1000 birds per day:	131	
e. Tons litter per 1000 bird capacity per year: (b x d /2000)	24	
f. Tons litter per year (a x e /1000)	192	

Turkey Brooder House Whole Litter	Example	Actual
a. Number of birds per flock:	20000	
b. Number of flocks per year:	7	
c. Average pounds market live weight per bird:	2.5	
d. Tons litter per 1000 birds per flock:	0.75	
e. Tons litter per year (a x b x d /1000):	105	

Turkey Grower Hen House Whole Litter	Example	Actual
a. Number of birds per flock:	12000	
b. Number of flocks per year:	3.4	
c. Pounds market live weight per bird:	16	
d. Tons litter per 1000 birds per flock:	5	
e. Tons litter per year (a x b x d /1000):	204	

Turkey Grower Hen House Manure Cake	Example	Actual
a. Number of birds per flock:	12000	
b. Number of flocks per year:	3.4	
c. Pounds market live weight per bird:	16	
d. Tons litter per 1000 birds per flock:	1.7	
e. Tons litter per year (a x b x d /1000):	70	

Turkey Grower Tom House Whole Litter	Example	Actual
a. Number of birds per flock:	8000	
b. Number of flocks per year:	3.4	
c. Pounds market live weight per bird:	25	
d. Tons litter per 1000 birds per flock:	7.5	
e. Tons litter per year (a x b x d /1000):	204	

Turkey Grower Tom House Manure Cake	Example	Actual
a. Number of birds per flock:	8000	
b. Number of flocks per year:	3.4	
c. Pounds market live weight per bird:	25	
d. Tons litter per 1000 birds per flock:	2.5	
e. Tons litter per year (a x b x d /1000):	70	

Turkey Stockpiled Litter	Example	Actual
a. Number of birds per flock:	8000	
b. Number of flocks per year:	3.4	
c. Pounds market live weight per bird:	25	
d. Tons litter per 1000 birds per flock:	6.6	
e. Tons litter per year (a x b x d /1000):	180	

Turkey Breeder House Whole Litter	Example	Actual
a. Number of birds production facility capacity:	6000	
b. Days per year birds in production facility:	365	
c. Pounds live weight per bird:	20	
d. Pounds litter per 1000 birds per day:	204	
e. Tons litter per 1000 bird capacity per year: (b x d /2000)	37	
f. Tons litter per year (a x e /1000):	222	

EXAMPLE ONE: NITROGEN

Worksheet: Crop Nutrient Requirement Worksheet. Use one worksheet per crop.	Example	Your Farm
1. Crop to be grown	Corn	
2. Crop realistic yield exceptions from Tables 3 or 4 or on farm records.	110 bu/acre	
3. Nitrogen fertilization guidelines per unit of yield based on soil type (see Table 1)	1.0 lb N/bu	
4. Crop Nitrogen requirement (2 X 3)	110 lb N/bu	
5. Starter fertilizer nitrogen (if needed)	25 lb N/acre	
6. Commercial fertilizer (if needed)	0 lb N/acre	
7. Crop Nitrogen need from poultry dry litter 4 minus 5	85 lb N/acre	
8. Poultry dry litter Plant-available Nitrogen a). Total nitrogen composition of litter from on farm sampling or enclosed Tables 2 or 4	38 lb N/acre	
b). Nitrogen availability coefficient (see Table 2) based on application method	0.5	
c). Plant-avaliable nitrogen (a x b) or from Waste analysis	19 lb N/ton	
9. Poultry dry litter application rate (7 divided by 8.c.)	4.5 ton/acre	
10. Acres of crop to be grown	95 acres	
11. Total litter required to meet the agronomic N requirement for this field (9 x 10)	427.5 tons	

Table 1. Crop Nitrogen Factors for Calculating Annual Realistic N Requirements per acre.

Crop	Suggested Nitrogen Application Rates	
	Loamy, Clayey Soils	Sandy, Leachable Soils
Crops Harvested for Grain or Fiber		
Corn (grain)	1.0 lb N per bu	1.25 lb N/bu
Sorghum (grain)	2.0 lb N per cwt	2.5 lb N/bu
Soybean (grain) (Manure Utilization Only)	3.8 lb N per bu	4.0 lb N per bu
Cotton	0.06 lb N per lb lint	0.12 N/lb lint
Wheat (grain)	1.7 lb N per bu	2.4 lb N/bu
Barley (grain)	1.4 lb N per bu	1.6 lb N/bu
Oats (grain)	1.0 lb N per bu	1.3 lb N/bu
Rye (grain)	1.7 lb N per bu	2.4 lb N/bu
Triticale (grain)	1.4 lb N per bu	1.6 lb N/bu
Silage, Hay, and Pasture Crops		
Corn (silage)*	10.0 lb N per ton	12.0 lb N per ton
Sorghum-sudangrass*	45.0 lb N per ton	55.0 lb N per dry ton
Bermudagrass*	40.0 lb N per ton	50.0 lb N per ton
Tall fescue*	40.0 lb N per ton	50.0 lb N per dry ton
Orchardgrass*	40.0 lb N per ton	50.0 lb N per dry ton
Timothy*	40.0 lb N per ton	50.0 lb N per dry ton
Annual ryegrass*	40.0 lb N per ton	50.0 lb N per dry ton
Small grain*	50.0 lb N per ton	60.0 lb N per dry ton
Millet*	45.0 lb N per ton	55.0 lb N per dry ton
Forest Species		
Pines**	40.0 lb N per year	60.0 lb N per year
Hardwood trees**	70.0 lb N per year	100.0 lb N per year

* Reduce N rate by 25 percent when grazing.
** On trees less than 5 feet tall, nitrogen will stimulate undergrowth competition.

Table 2.
Average nutrient content of litter and N availability factors by production system and handling method.

		N Availability Factor			
	Total N	Broadcast	Incorporated	Total P2O5	Total K2O
	lb/ton	0.5xlb.T.N/ton	0.6xlb.T.N./ton	lb/ton	
Poultry House Litters					
Chicken					
broiler	72.3	36.15	43.38	78.5	45.8
roaster	73.3	36.65	43.98	74.8	44.9
breeder	31.2	15.60	18.72	54.0	31.0
Turkey					
poult	45.3	22.65	27.18	52.0	32.1
grower hen	57.2	28.60	34.32	72.5	40.4
grower tom	57.2	28.60	34.32	72.5	40.4
Poultry Stockpiled Litters					
Broiler	35.6	17.80	21.36	79.6	34.5
Turkey	35.7	17.85	21.42	72.3	33.0

EXAMPLE TWO: PHOSPHORUS

Worksheet: Crop Nutrient Requirement Worksheet. Use one worksheet per crop.	Example	Your Farm
1. Crop to be grown	Corn	
2. Crop realistic yield exceptions from Tables 3 or 4 or on farm records.	80 bu/acre	
3. Crop Phosphorus requirement from Tables 3 or 4	42 lb P/acre	
4. Commercial fertilizer (if needed)	0 lb N/acre	
5. Crop Phosphorus need from poultry dry litter (3 minus 4).	42 lb P/acre	
6. Total phosphorus composition of litter from farm sampling, or see Table 2 or 4.	82 lb P/ton	
7. Poultry dry litter application rate (6 divided by 5)	0.5 ton/acre	
8. Acres of crop to be grown	95 acres	
9. Total litter required to meet the agronomic phosphorus requirement for this field (8 x 9)	50 tons	

Table 3. Crop Nutrient Utilization.
Source: Potash Phosphate Institute of America.

Crop	Yield	N	P_2O_5	K_2O
			lb/acre	
Corn	80 bu	121	42	77
	100 bu	160	60	120
	150 bu	185	80	215
	180 bu	240	100	240
Corn Silage	16 tons	130	45	102
	32 tons	200	80	245
Soybeans	30 bu	123	32	52
	40 bu	180	45	80
	50 bu	257	48	120
	60 bu	336	65	145
Grain Sorghum	4 tons	250	90	200
Wheat	40 bu	70	30	50
	60 bu	125	50	110
	80 bu	186	54	162
Oats	80 bu	75	35	95
	100 bu	150	55	150
Barley	65 bu	74	32	63
	100 bu	150	55	150
Alfalfa	4 tons	180	40	180
	8 tons	450	80	480
Orchardgrass	6 tons	300	100	375
Brome grass	5 tons	166	66	254
Tall fescue	3.5 tons	135	65	185
Blugrass	3 tons	200	55	180
Costal Bermuda grass	4 tons	225	40	160
	10 tons	535	145	410
Clover grass	4.5 tons	185	60	175
	6 tons	300	90	360
Sugar beets	30 tons	275	85	550
Rice	2.25 tons	110	45	110
	3.5 tons	112	60	168
Timothy	4 tons	150	55	250
Panola grass	12 tons	299	108	430
Sorghum-Sudan grass	8 tons	319	122	467

from MWPS-18, Midwest Plan Service, Iowa State University, Ames, IA.

EXAMPLE THREE

DETERMINE RATE OF BROILER LITTER APPLICATION

1. Determine nutrient recommendation (lbs/ac) for crop to be grown from either Table 3 or 5:

Crop _____

	N	P2O5	K2O
Nutrient requirement (Lbs/Ac)	_____	_____	_____
2. Soil Test	_____	_____	_____
3. Broiler Litter Analysis: (Use Table 4 if analysis is not available.)	_____	_____	_____

4. Subtract the nitrogen in the soil from the nitrogen the crop requires.

	N		
N crop requires	_____		
N in soil	_____		
(Soil test PPM X 2)			
Total N required	_____	_____	_____

5. Determine rate of broiler litter to apply. (lbs/ac)
N crop requires = Rate/litter, Tons/ac.
N in litter _____ _____

6. Nutrient balance:	N	P2O5	K2O
Pounds nutrients required by crop (#4)	_____	_____	_____
Pounds nutrients applied in _____tons litter (No. 5 x No. 3)	_____	_____	_____
Total (lbs./ac)	_____	_____	_____

7. Determine if the amount of phosphorus applied is greater than twice the amount of phosphorus needed by the crop or grass. If this is true, the rate of broiler litter should be reduced one ton per acre, or until the amount of phosphorus applied is no greater than twice the amount of phosphorus required by the crop should be applied.

	N	P2O5	K2O
Nutrient Balance:			
Pounds nutrients required by crop:			
Pound nutrient supplied by _____ tons litter:			
Balance:			

8. The amount of commercial fertilizer needed to meet crop requirements after _____ tons of broiler litter is applied.

N	P2O5	K2O

Table 4. Crop yield goals versus nutrient recommendation.

Crop	Yield Goal	Nutrient Recommendation (lbs/acre)		
		N	P2O5	K2O
Corn	75-99 bu/acre	75-100	60	20
	100-149 bu/acre	110-165	80	130
	150-200 bu/acre	180-240	80	140
Cotton	1.0 bale/acre	40	40	30
	1.5 bales/acre	60	60	50
	2.0 bales/acre	80	80	80
	2.5 bales/acre	100	80	80
Grain Sorghum	1500-2000 lbs/acre	30-40	20	20
	2000-4000 lbs/acre	40-80	40	80
	4000-6000 lbs/acre	80-120	60	100
	6000-8000 lbs/acre	120-160	80	120
Wheat	20-30 bu/acre	40-60*	20	20
	30-40 bu/acre	60-80	40	30
	40-60 bu/acre	80-120	40	40
	60-80 bu/acre	120-160	60	60
	80-100 bu/acre	160-200	60	60
Coastal Bermuds	grazing only	100-160	50	90
	1 cutting + grazing only	160-220	50	150
	3 cuttings	300-350	100	300
	4-6 cuttings	400-600	130	400
Alfalfa	non-irrigated, annually	20	60	120
	irrigated> 6 T/acre	20	100	120
	irrigated > 8-12 T/acre	20	140	200
Clover	annually	20	80	120
	sod seeded	20	80	120
	with ryegrass/small grain	40	80	120
Wheat	light grazing**	160	60	60
	moderate grazing	200	80	120
	heavy grazing	240	80	120
Sorghum/Sudan	1 cutting/light grazing	80	40	40
	2 cuttings/medium grazing	160	60	60
	3 cuttings/heavy grazing	200	80	80

Source: Texas Agricultural Extension Service Soil Testing Laboratories, College Station and Lubbock.

[redacted]

SOIL AND MANURE SAMPLINGS

[redacted]

APPLICATION SITE SOIL SAMPLING

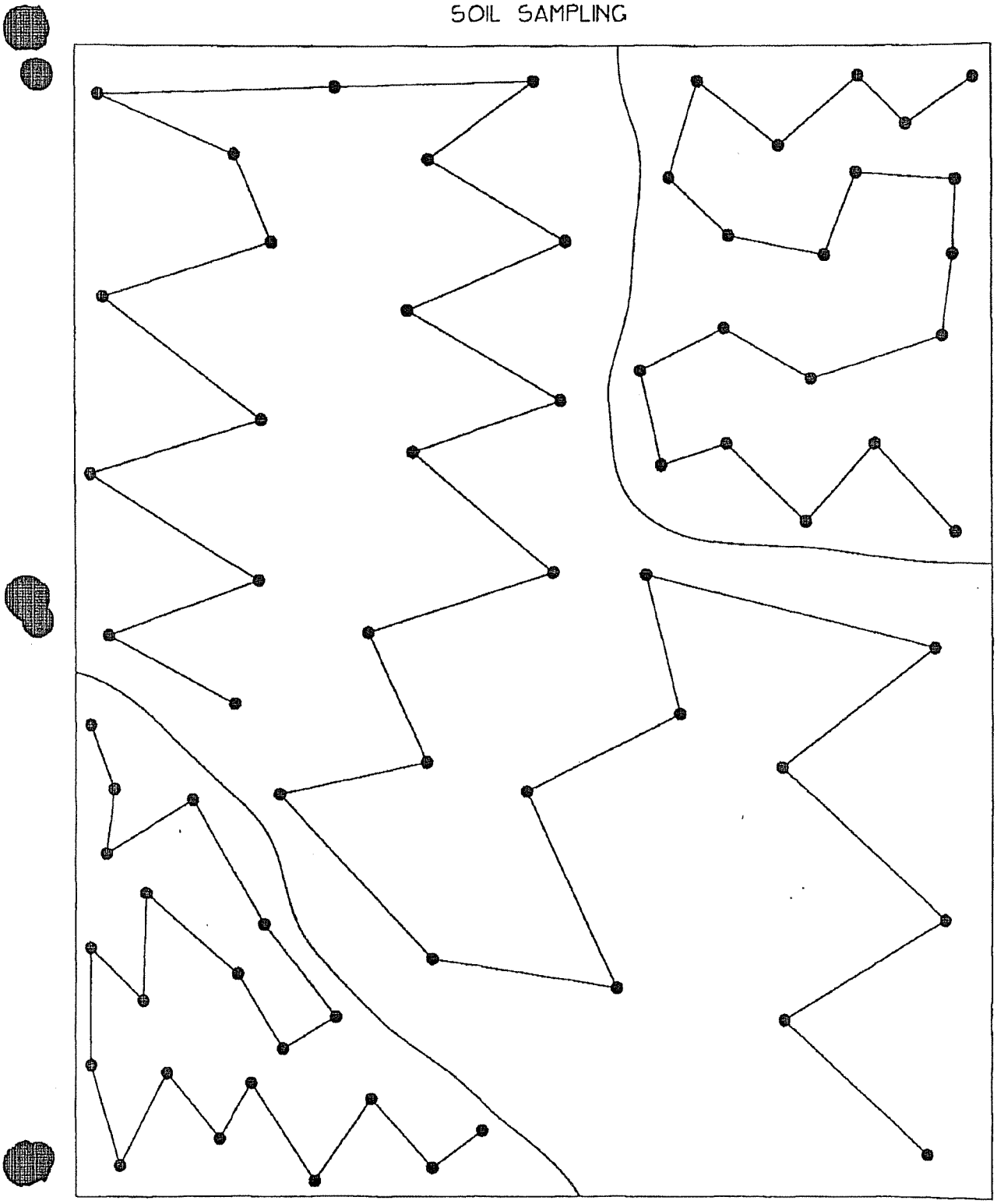
All manure application fields which receive poultry manure should be sampled annually. The Nutrient Management Plan will include a site map of all application fields which should be sampled. Soil samples should be collected and submitted to the testing laboratory prior to the end of April or at least one month prior to the beginning of the active growing season. The sampling results will detail nutrient and mineral concentrations of the soil. The sampling laboratory will usually include fertilizer recommendations to further maximize crop nutrient needs along with the sampling results.

Sampling Laboratory

Soil analysis is usually provided by the State Cooperative Extension Service. Private soils testing laboratories can also be utilized for analysis. The local county Extension Office or private lab should be contacted for details on sampling methods and recommended analysis. Generally, the Extension Office or laboratory will provide sampling instructions, information sheets, and sampling boxes. Depending on the state, a nominal fee is sometimes charged for analysis done by the state. Private laboratory fees can vary. Each sample should be analyzed for, at a minimum, nitrogen, phosphate, and potassium. The Cooperative Extension Service or sampling laboratory will usually provide information or consultation to explain the results of the analysis.

Collecting Soil Samples

To collect samples, a small volume of the soil should be taken from approximately 20 random locations in each application field. The enclosed diagram illustrates several different sized fields and suggestions for sampling patterns. Soil should be collected from a depth of four to six inches below the surface at sampling location. The small samples should then be thoroughly mixed in a plastic bucket. A portion of this larger sample should then be air dried and poured into the provided sample box and submitted to the Extension Service or soil testing laboratory.



Sampling patterns for different field sizes

POULTRY LITTER SAMPLING

Prior to application, a representative poultry manure sample should be taken and analyzed. The nutrient concentration of the manure will allow the producer to accurately calculate application rates according to the Nutrient Management Plan.

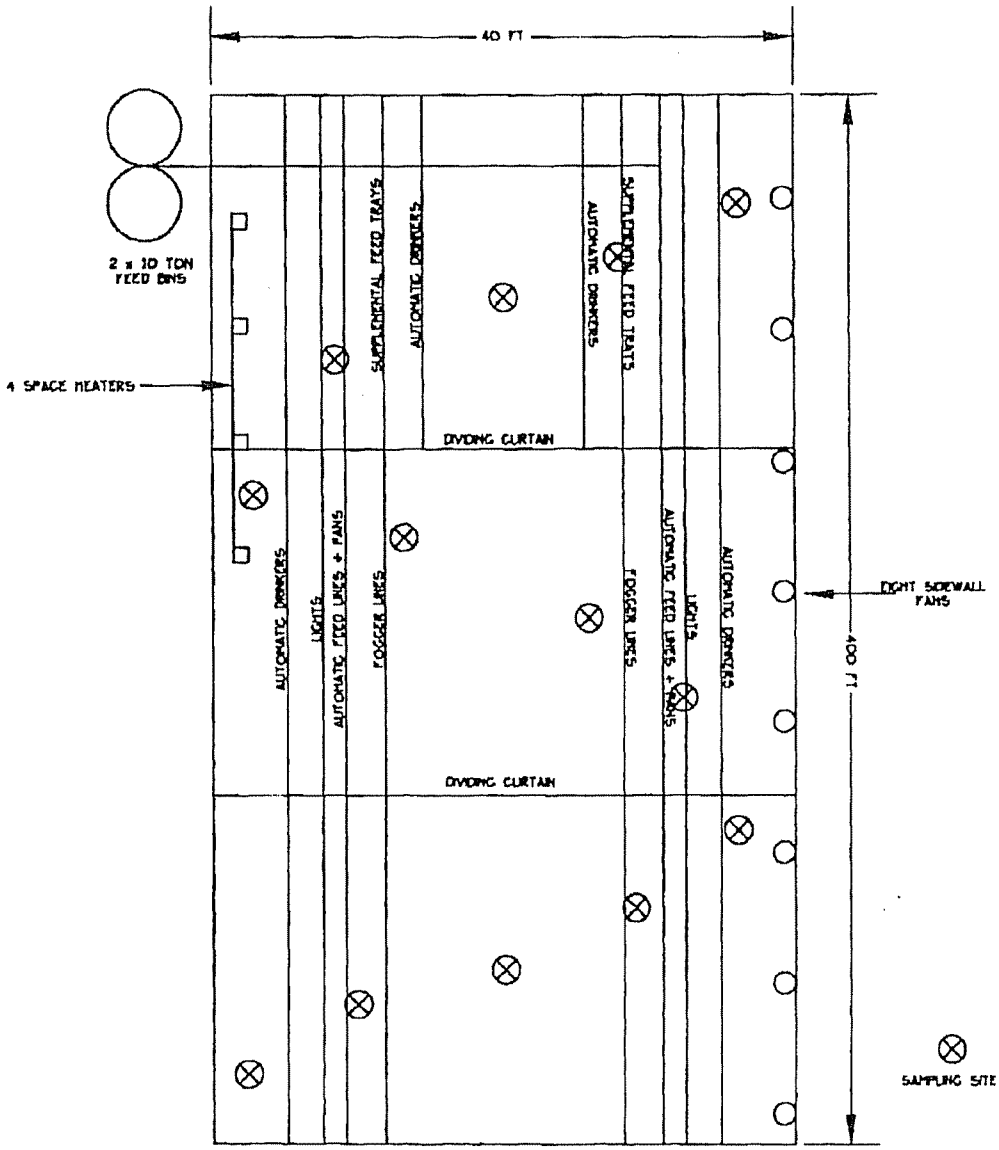
Sampling Laboratory

The local Cooperative Extension Service is usually available to conduct analysis of the manure. Also, a private laboratory can be used for analysis. Please contact the sampling laboratory prior to actually collecting the sample. The sampling laboratory will usually provide a sample identification form. At a minimum, the manure should be sampled for nitrogen, phosphorous, and potassium. It is recommended that calcium, magnesium, sulfur, iron, manganese, zinc, and copper be included in the analysis. The Cooperative Extension Service or sampling laboratory should also provide information or consultation to explain the results of the analysis.

Sample Collection

The sample should be composed of approximately 20 smaller samples taken from random locations within each house. The enclosed diagram illustrates potential sampling locations. The samples should be representative of the clean-out material. Cake litter samples should also be taken and analyzed prior to its removal and application. Mix the smaller samples in a plastic bucket. Pour a portion of the thoroughly mixed sample into a quart size plastic bag. Close the bag and write farm and house identification information and submit to the Extension Service or private laboratory.

SCHEMATIC OF SAMPLING LOCATION WITHIN A POULTRY HOUSE



NOTE: FROM THE NORTH CAROLINA "DRY POULTRY LITTER HANDBOOK"

RECORD KEEPING FORMS

The sheets in this section will help the producer keep field application records, field application rates, and also help with determining the amount of manure taken from his individual houses.

Record keeping provides a convenient reference that allows the producer to maximize manure fertilizer usage. The records also ensure that the volume of manure applied is following the Nutrient Management Plan. The following sheets will allow the grower to "follow" the manure from when it leaves the individual house to the application site. This is especially useful when manure is sold or given away.

Dry Litter Cleanout Records

Farm Owner		3rd Party Applicator	
Owner's Address		3rd Party's Address	
Owner's Phone #		3rd Party's Phone #	

(1)	(2)	(3)	(4)	Use of Litter				
Date mm/dd/yy	# of loads removed	Spreader Volume* (cubic feet)	Spreader Capacity** (tons)	Total Removal (tons) (4) x (2)	Temporary Storage (tons)	Spread on Farm (tons)	Removed from farm (tons)	Other*** (tons)
			TOTALS					

* Can be found in operator's manual for the spreader. Contact a local dealer if you do not have your owner's manual.

** See attached sheet for formula.

*** Indicate use (i.e., cattle feed, composted soil ammendment, commercially distributed organic fertilizer, etc.)

Dry Litter Application Field Record
For Recording Dry Litter Application Events on Different Fields

Farm Owner _____

Spreader Operator _____

Tract #	Field #	Date (mm/dd/yy)	Crop Type	Field Size (acres)	Application Method*	# of Loads per Field	Volume of Loads** (cubic feet)	Spreader Capacity*** (tons)

* SI= Soil incorporated (disked); BR= broadcast (surface applied)

**Can be found in operator's manual for the spreader. Contact a local dealer if you do not have your owner's manual.

***See attached calibration sheet for the formula.

Dry Litter Application Field Record
One Form for Each Field Per Crop Cycle

Tract # _____ Field # _____

Fld. Size (ac)=(A) _____

Farm Owner _____

Owner's Address _____

Owner's Phone # _____

Spreader operator _____

Spreader Oper. Address _____

Spreader Operator _____

From Animal Waste Management Plan

Crop Type _____

Recommended Loading (lb/acre) = (B) _____

(1) Date (mm/dd/yy)	(2) # of Loads per Field	(3) Wt. of Loads* (tons)	(4) Total wt. (tons) (2) x (3)	(5) Wt. Per Acre (tons/ac) (4) ÷ (A)	(6) Waste Analysis** PAN (lb/ton)	(7) Nutrient Applied (lb/ac) (6) x (5)	(8) Nutrient Balance*** (lb/ac) (B) - (7)
Crop Cycle Totals							

Owner's Signature

Spreader Operator's Signature

* Can be found in operator's manual for the spreader. Contact a local dealer if you do not have your owner's manual.

** See your waste management plan for sampling frequency. At a minimum, waste analysis is required within 60 days of land application events.

***Enter the value received by subtracting column (7) from (B). Continue subtracting column (7) from column (B) following each application event.

ANIMAL WASTES APPLICATION RECORDS

PRODUCER'S NAME:____________________________________

WASTE APPLICATION YEAR:______________________________

FIELD NO.	LAND OWNER	DATE	ACRES COVERED	APPROX. VOLUME APPLIED

EQUIPMENT CALIBRATION

CALIBRATION OF APPLICATION EQUIPMENT

Spreader Calibration

Proper calibration of manure spreading equipment controls the amount or volume applied. Calibration ensures the spread of nutrients according to the Nutrient Management Plan. Poultry growers can calibrate their equipment by using site-specific soils, manure, and plant data which maximizes economic returns of land application.

Technical assistance is available from the Natural Resources Conservation Service, Cooperative Extension Service, and other Federal, State and local producer support agencies. Information sheets from these agencies are usually available which will help growers determine spreader capacity and application rates. Below are examples to help producers calibrate spreader equipment.

Calibration

To begin calibration, locate an open area which is fairly smooth. Spread a large plastic sheet or tarp over the ground. The following table "Calibrating of Manure Spreaders" uses tarp sizes of 8' x 8', 10' x 10', and 10' x 12' for calibrations. Fill the spreader and drive it over the tarp as it is applying manure. To collect a representative sample, the manure spreader should be driven at least three times over the tarp. Next, use a scale and weigh a plastic bucket. Record the weight. Pour the manure collected into the bucket and weigh. Subtract the weight of the bucket from this weight. This will then be the weight of the manure. The producer should repeat the above calibration procedure three times and then average the weight of the material applied.

Calculation of Application Rate

The following table can be used to determine application rate if the weight of the sample and size of the tarp are known. The application rate can also be determined by using the formula below:

$$\text{Application Rate (tons/ac)} = \frac{\text{weight of manure} \times 21.78}{\text{tarp length} \times \text{tarp width}}$$

The application rate of the manure can also be adjusted by changing the speed at which the manure is applied. The following formulas can be used for calibration. To correctly utilize the formulas, the producer must know: the spreader load capacity in tons, application time in minutes, and the average width of the manure spread from the applications in feet.

$$\text{Application Rate (tons/ac)} = \frac{\text{spreader load} \times 495}{\text{time} \times \text{width} \times \text{speed}}$$

$$\text{Travel Speed (mph)} = \frac{\text{spreader load x 495}}{\text{time x width x application rate}}$$

Spreader Pattern

The uniformity of the manure spread and determination of spreader overlap can easily be determined. To do so, place several small sized approximately 12" x 12" or 15" diameter pans, 2' to 4' across the spreader path. Next, drive the spreading equipment through the middle of the pan arrangement. Weigh the manure in each of the pans or visually compare the amounts in each pan. The width of the manure spread can be determined by comparing the volume or the lack of material in each pan. Once the width is determined, application can overlap the edges to ensure uniform coverage.

CALIBRATING OF MANURE SPREADERS

SIZE OF PLASTIC SHEET OR TARP			
Pounds of Manure Applied to Sheet	8' X 8'	10' X 10'	10' X 12'
	Tons of Manure Applied Per Acre		
1	0.34	0.22	0.18
2	0.68	0.44	0.36
3	1.02	0.65	0.54
4	1.36	0.87	0.73
5	1.70	1.09	0.91
6	2.04	1.31	1.09
7	2.38	1.52	1.27
8	2.72	1.74	1.45
9	3.06	1.96	1.63
10	3.40	2.18	1.82
11	3.74	2.40	2.00
12	4.08	2.61	2.18
13	4.42	2.83	2.36
14	4.76	3.05	2.54
15	5.10	3.27	2.72
16	5.45	3.48	2.90
17	5.79	3.70	3.09
18	6.13	3.92	3.27
19	6.47	4.14	3.45
20	6.18	4.36	3.63
21	7.15	4.57	3.81
22	7.49	4.79	3.99

BEST MANAGEMENT PRACTICES

Best Management Practices (BMP's) have been utilized on poultry farms for several years. The BMP's address manure handling practices, filter strips, soil and litter testing, and record keeping. The following is a discussion of different management practices which may be applicable to poultry producers.

Composting

Composting can be used to biologically stabilize manure into a beneficial soil amendment. Producers can mix crop residuals, by-products, and other "waste" materials with manure for composting. Composting reduces odor and flies. Heat generated during composting destroys harmful organisms which may be within the manure. The volume of the final compost product is less than the volume of the initial manure, saving the producer hauling and spreading expense.

Field Buffer Zones

Field borders are vegetated strips which are established at the edge of application sites. The buffers reduce erosion and the runoff of manure from the application site. The reduction of nutrient runoff enhances overall water quality.

Riparian Buffer Zones

Grass or forest filter strips can protect water quality proximal to poultry farms and application sites. The vegetated strips act to filter excess nutrients from runoff. The plants in the filter strip then utilize the nutrients for their nutritional needs. The strips do remove acreage from production, but the reduction of adverse impacts to water quality demonstrates good environmental stewardships. Contact the local Natural Resources Conservation Service, Cooperative Extension Service, or other grower support agency for additional details.

Acceptable Best Management Practices

The following is a general listing of Best Management Practices from the Texas Agricultural Extension Service which can reduce adverse water quality impacts from poultry operations:

1. All litter stockpiled or retained on site shall:
    a. Be stored under cover to be protected from rainfall
    b. Be placed on impermeable clay or concrete to prevent infiltration
    c. Be isolated from all run-off waters by dikes, terraces, berms, ditches or other structures

2. Maintain grass filter or barrier strips between manure application fields and streams or lakes, and other water sources.

3. Do not spread broiler litter within 150 feet of any water well, or 100 feet from a highway and neighboring property line.

4. Do not apply litter to land with slopes greater than 15 percent.

5. Soil test 4-6 inches deep each year and maintain results.

6. Sample litter before application

7. Cover trucks hauling litter more than one mile.

8. Do not apply litter to frozen or saturated soils or during rain or snowfall.

9. Do not apply litter to highly erodible lands.

10. Inform neighbors when you will be applying litter.

11. Apply manure early in the week. Avoid spreading on Fridays or during the weekend.

12. Maintain records:
    a. Where litter was applied
    b. How much litter applied per acre
    c. When litter applied and to what crop
    d. Anyone you sold or gave litter to
    e. Location where litter will be applied by producer you sold or gave litter to.

Odor Control

The following table is of Best Management Practices to control odors which may result from poultry operations.

Poultry Farm Waste Management Odor Control Checklist:

Source	Cause	BMPs to Minimize Odor
Farmstead	Poultry Production	Vegetative or wooded buffers Recommended best management practices Good judgment and common sense
Ventilation exhaust fans	Volatile gases Dust	Fan maintenance Efficient air movement
Indoor surfaces	Dust	Vacuum and washdown between flocks
Feeders	Feed spillage	Design, operate and maintain feed system to minimize accumulation of decaying wastage. Clean up spillage on a routine basis
Feed storage	Decomposition of accumulated feed residues	Reduce moisture accumulation within and around immediate perimeter of feed storage by ensuring drainage is away from site and/or providing adequate containment Clean up spillage on a routine basis
Litter storage and handling areas	Decomposition of accumulated manure	Remove spillage on a regular basis Provide for adequate drainage around manure stockpiles Inspect for and remove or break up accumulated wastes in filter strips around stockpiles and manure handling area as needed.
Dead birds	Carcass decomposition	Proper disposition of carcasses
Incinerators	Incomplete combustion	Secondary stack burners

Source	Cause	BMPs to Minimize Odor
Dead bird disposal pits	Carcass decomposition	Complete covering of carcasses in burial pits Proper location/construction of burial pits Disposal pit covers tight fitting
Standing water around facilities	Improper drainage Microbial decomposition of organic matter	Grade and landscape such that water drains away from facilities
Mud tracked onto public roads from farm access	Poorly maintained access roads	Farm access road maintenance

(From the North Carolina "Dry Poultry Litter" Handbook)

Transportation of Poultry Manure

In the U.S., the majority of poultry producers are concentrated within a 40 mile radius of the complex feed mill, hatchery, and processing plant. Producers must monitor their application soils for nutrient build-up. If excess nutrient concentrations are determined by soil sampling, the producer must either increase the number of application sites or transport the manure to other areas. In locations where suitable spreading lands are not available, other uses and markets must be determined and implemented for the manure.

Should more than one poultry production company operate in the same geographic area, then the competition for suitable application acres can be rather intense. Producers could form cooperative agreements with one another to establish markets and alternative uses for their manure. The final users of the product could even be several hundred miles from the poultry farms which generated the manure. Transporting manure out of areas with high nutrient concentrations can greatly reduce the potential for water quality impacts.

The manure from disease free farms should only be that which is transported to outside locations. All trucks used for manure transport should be properly cleaned and disinfected to prevent adverse health impacts. The manure should also be covered to prevent it from being blown out of the truck during transport. If the manure is to be stored on-site while awaiting transport, it must be covered to prevent contact with precipitation. The manure should also be stored in plies to promote the compost process which can control the spread of harmful bacteria.

MANURE STOCKPILES AND STORAGE STRUCTURES

When poultry manure is removed from houses, it is not always possible to land apply immediately. Delays to application can include the time of the year, plant growing season, and inclement weather.

Permanent Structures

A roofed structure is the preferred method to store manure prior to application. Such structures must have their foundations constructed from concrete or of an impermeable clay. This eliminates runoff and leaching to ground and surface waters. The roof eliminates the introduction of excessive moisture which can lead to a reduction of nutrients.

Temporary Structures

Producers can use windrow or bunker type arrangements for temporary manure storage facilities. The temporary structures must also be covered and foundation constructed of impermeable clay or concrete to protect the manure from rainfall and runoff.

Temporary structures should be sited in areas which are well-drained to avoid the collection of rain water. The site should be at least 100' from surface waters and drinking water sources. Filter strips should also be maintained around temporary structures to prevent nutrient runoff.

Preventing Fires in Storage Structure

The following guidelines will help reduce the potential for fires:

- keep the litter dry and away from the end of the barn
- do not mix the wet cake with dry litter
- limit stack height to less than 5 feet
- internal temperature of the stack should not exceed 180 °F


MORTALITY
MANAGEMENT

MORTALITY MANAGEMENT

Producers are beginning to implement environmentally sound measures for disposal of their dead poultry. If not properly disposed, dead birds can cause odor, water quality, disease, insect, rodent, and small animal problems. Proper disposal methods can include rendering, composting, incineration, and disposal pits. Information of disposal methods can be obtained at the local office of the Natural Resources Conservation Service or Cooperative Extension Service.

Rendering Conversion

Rendering is an excellent dead bird disposal method. Almost 100% of the bird can be converted into alternative uses. Rendering removes mortalities from the farm which also eliminates the potential for adverse environmental impacts. Tyson is providing its growers with freezers to chill the dead birds prior to transport to the rendering facility.

Composting

Composting dead birds is another practical and economic method of dead disposal. The final product can be used as a soil amendment or conditioner. Besides the birds, waste materials such as litter, straw, and by-products can be used for compost.

Incineration

One of the major advantages of incineration is the virtual elimination of adverse water impacts. Incinerators, though, need to be carefully sited to reduce possible odor complaints. Poultry growers must address air quality issues such as odor and dust which can be generated by incineration. Producers considering incineration should contact state and local environmental agencies for regulatory measures which must be adopted for design and use.

Disposal Pits

Burial of dead birds in open pits and trenches is not an acceptable disposal practice. States that do allow burial, usually require the installation of fabricated units or boxes. Disposal pits require little labor, but must be properly maintained to prevent nuisance complaints.

Disposal pits can be constructed from several sources which include concrete, concrete blocks, or treated timbers. A septic tank could even be used for the disposal pit. The structure usually has one or more openings to the surface to allow the dead birds to be placed inside. The openings should always be covered to prevent the escape of unpleasant odors.

The disposal pit should be located at least 200' from dwellings, 300' from water sources, and 25' from the poultry houses. The pit should be located in soils with good drainage to prevent ponding of rain. The bottom of the pit should be at least five above the elevation of the highest known water table.